CLAIMS

What is claimed is:

1. An apparatus for measuring the relative displacement between a first shaft and a second shaft, comprising:

a first rotor assembly being coupled to the first shaft and being centered on an axis;

at least one magnet having a magnetic field and being disposed on the first rotor assembly;

a second rotor assembly being coupled to the second shaft, the first and second rotor assemblies being coaxial, the second rotor assembly having a first stator plate and a second stator plate, each of the first and second stator plates having an upper surface and a lower surface, the upper and lower surfaces being parallel, the first and second stator plates having a plurality of teeth extending in a direction radial of the axis, each tooth having upper surface and a lower surface, the upper surface of each tooth being planar with the upper surface of the respective stator plate, the lower surface of each tooth being planar the lower surface of the respective plate, the first and second stator plates forming a gap between the lower surface of the first stator plate and the upper surface of the second stator plate, the gap having a uniform thickness; and,

a sensing device disposed within the gap for sensing a magnetic flux of the magnetic field.

2. An apparatus, as set forth in claim 1, further comprising a compliant member coupled between the first and second shafts for allowing relative movement therebetween.

3. An apparatus, as set forth in claim 1, further comprising a retaining member to hold the first and second stator plates and fixing the relative position thereof, respectively, and being fixedly coupled to the lower shaft.

4. An apparatus, as set forth in claim 3, each stator plate including a circular base section, the plurality of teeth extending from the circular base section.

5. An apparatus, as set forth in claim 1, the measuring device being mounted to a stationery member or to a bearing surface.

6. An apparatus, as set forth in claim 3, the retaining member including a bore for being press-fit onto the second shaft.

7. An apparatus, as set forth in claim 3, the retaining member being made from a non-magnetic material.

8. An apparatus, as set forth in claim 3, the retaining member being made from plastic.

9. An apparatus, as set forth in claim 3, the first and second stator plates being glued and/or crimped to the retaining member.

10. An apparatus, as set forth in claim 3, the retaining member being overmolded the first and second stator plates.

11. An apparatus, as set forth in claim 1, wherein the first and second stator plates are made using a stamping process or a metal injection molding process or a casting process.

12. An apparatus, as set forth in claim 1, wherein the first and second stator plates are made from a powdered metal using a sintering or bonding process.

13. An apparatus, as set forth in claim 1, the first rotor assembly having a circumference and a plurality of slots spaced evenly around the circumference, the apparatus including a plurality of magnets, each magnet being located in one of the slots

14. An apparatus, as set forth in claim 13, the plurality of magnets being uni-polar.

15. An apparatus, as set forth in claim 13, each magnet having first and second parallel surfaces and four side surfaces, the first and second parallel

surfaces being parallel to the axis, at least one pair of opposite edges formed by one of the side surfaces and the first parallel surface being rounded.

16. An apparatus, as set forth in claim 13, each magnet having first and second parallel surfaces and four side surfaces, the first and second parallel surfaces being parallel to the axis, the first and second parallel surfaces being rectangular.

17. An apparatus, as set forth in claim 13, each magnet having first and second parallel surface and four side surfaces, the first and second parallel surfaces being parallel to the axis, the first and second parallel surface being square.

18. An apparatus, as set forth in claim 13, the plurality of magnets being in a single row around the circumference of the first rotor assembly.

19. An apparatus, as set forth in claim 13, the plurality of magnets being in two rows around the circumference of the first rotor assembly.

20. An apparatus, as set forth in claim 1, the first rotor assembly having a circumference, the at least one magnet being a ring magnet.

21. An apparatus, as set forth in claim 20, further comprising a second ring magnet, the first and second ring magnets being in parallel planes perpendicular to the axis.

22. An apparatus, as set forth in claim 1, further comprising a second sensing device having a displacement from the other sensing device such that any changes in magnetic flux at constant displacement between the first and second rotor assemblies over 360 degrees will have the same effect on each device.

23. An apparatus, as set forth in claim 1, the teeth of the first and second stator plates being in phase.

24. An apparatus, as set forth in claim 1, the teeth of the first and second plates being out of phase.

25. An apparatus, as set forth in claim 24, an edge of one of the teeth of one of the first and second plates being adjacent with an edge of one of the teeth of the other of the first and second plates.

26. An apparatus, as set forth in claim 25, at least a portion of the edge of one of the teeth of one of the first and second plates and at least a portion of the edge of one of the teeth of the other of the first and second plates overlapping.

27. An apparatus, as set forth in claim 25, at least a portion of the edge of one of the teeth of one of the first and second plates and at least a portion of the edge of one of the teeth of the other of the first and second plates forming a gap.

28. A rotor assembly for use in a sensor for measuring relative displacement between first and second shafts, comprising:

a first stator plate having an upper surface and a lower surface, the upper and lower surfaces being parallel;

a second stator plate having an upper surface and a lower surface, the upper and lower surfaces of the second stator plate being parallel, the first and second stator plates having a plurality of teeth, the first and second stator plates forming a gap between the lower surface of the first stator plate and the upper surface of the second stator plate; and,

a retaining member to hold the first and second stator plates, respectively.

29. An apparatus, as set forth in claim 28, each stator plate including a circular base section, the plurality of teeth extending from the circular base section.

30. An apparatus, as set forth in claim 28, the retaining member substantially enclosing the first and second stator plates for fixing the relative position thereof.

31. An apparatus, as set forth in claim 28, the retaining member being made from a non-magnetic material.

32. An apparatus, as set forth in claim 28, the teeth of the first and second stator plates being in phase.

33. An apparatus, as set forth in claim 28, the teeth of the first and second plates being out of phase.

34. An apparatus, as set forth in claim 28, the teeth extending in a direction radial of an axis, each tooth having upper surface and a lower surface, the upper surface of each tooth being planar with the upper surface of the respective stator plate, the lower surface of each tooth being planar the lower surface of the respective plate.

35. An apparatus, as set forth in claim 28, the retaining member being overmolded the first and second stator plates.

36. An apparatus, as set forth in claim 28, the first and second stator plates being glued and/or crimped to the retaining member.

37. A rotor assembly for use in an apparatus for measuring the relative position between first and second shafts, comprising:

a rotor centered on an axis, the rotor having an inner surface and an outer surface, the outer surface forming at least one slot associated with an outer radius, the inner surface forming at least one support structure associated with an inner radius, the inner radius being larger than the outer radius; and,

at least one magnet disposed in the at least one slot.

38. A rotor assembly, as set forth in claim 37, further comprising a retaining member surrounding the rotor assembly for retaining or adhering the at least one magnet in the respective slot.

39. A rotor assembly, as set forth in claim 38, the retaining member being made from a non-magnetic material.

40. A rotor assembly, as set forth in claim 37, the rotor having a circumference and a plurality of slots spaced evenly around the circumference, the rotor assembly including a plurality of magnets located in one of the slots.

41. A rotor assembly, as set forth in claim 40, the plurality of magnets being uni-polar and in a single row around the circumference of the first rotor assembly.

42. An apparatus, as set forth in claim 40, the plurality of magnets being in two rows around the circumference of the first rotor assembly.

43. An apparatus, as set forth in claim 40, the at least one magnet being a ring magnet.

44. An apparatus, as set forth in claim 38, the retaining member being overmolded the rotor and at least one magnet.

45. An apparatus, as set forth in claim 37, the rotor having a non-continuous inner diameter.

46. An apparatus, as set forth in claim 37, wherein hoop stress is eliminated in the rotor assembly by having the inner radius larger than the outer radius and a non-continuous inner diameter.